

REMARKS

The examiner is thanked for thoroughly reviewing the subject patent application. Applicants wish to point out the major features of their invention, which is a magnetoresistive read head with a laminated shield structure for improved head stability and performance. Briefly, Applicants have discovered that magnetic shields formed of layers of ferromagnetic material separated by thin layers of ruthenium can be strongly exchange coupled in an antiferromagnetic configuration to produce shields possessing a high degree of magnetic stability. As is disclosed in the subject application, the ferromagnetic layers can be single layers of ferromagnetic material, or can be layers of ferromagnetic material with additional layers of CoFe inserted at the interfaces of the ruthenium layer for an enhancement of the exchange coupling. The ruthenium serves as an exchange coupling layer and must be formed within a specific range of thicknesses in order to produce the desired exchange effect. The claimed invention comprises a magnetoresistive (MR) read head surrounded above and below by such shields.

Claim Rejections and Objections Under 35 USC 102.

Examiner has pointed out that Ravipati (U. S. Patent No. 5,838,521) also claims a magnetoresistive structure surrounded by laminated shields. Although the laminated shields taught by Ravipati are not the ruthenium exchange coupled shields of the present invention, independent claim 51 of the subject application, claiming only laminated shields, is anticipated by Ravipati and is, therefore, objected to by Examiner under 35

USC 102. Examiner, however, suggests that claims 52-101, which are objected to as being dependent from rejected claim 51, would be allowable if rewritten as independent claims including the limitations in claim 51 and intervening claims. The purpose of the amendments in this response, therefore, is to follow the suggestion of the Examiner in as efficient a way as possible and rewrite claims 52-101 in an allowable manner. To do so, Applicants respectfully request that rejected claim 51 be canceled and that amended claims 52, 64, 77 and 89, which now incorporate the limitations of claim 51 along with the original limitations of claims 52, 64, 77 and 89, be accepted. As presently amended, claims 52, 64, 77 and 89 are now independent claims claiming the MR read head surrounded by laminated shields, in which one of the shields (the first shield in claims 52 and 64 and the second shield in claims 77 and 89) is a laminate of ferromagnetic layers separated by a ruthenium layer. These claims, therefore, are no longer anticipated by Ravipati. Claims 53-63 now depend from amended claim 52, claims 65-76 now depend from amended claim 64, claims 78-88 now depend from amended claim 77 and claims 90-101 now depend from amended claim 89. These claims simply claim material and dimensional limitations for the laminated layers in the shield. Since Applicants believe that amended claims 52, 64, 77 and 89 should now be allowable independent claims, the claims depending from them should also be allowable. Applicants believe that these amendments meet the suggestions of Examiner in an efficient manner and that claims 52, 64, 77 and 89 are now acceptable as amended and respectfully request a reconsideration of the objection.

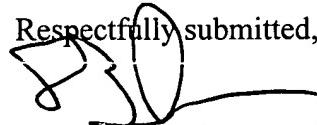
Examiner is also requested to accept Fig. 1 as amended to include the legend "Prior Art," which should have been present in the original figure.

We have reviewed the accompanying related art references and agree with the Examiner that neither they nor the Prior Art of record suggest the present claimed invention.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned:

Version with markings to show the changes made."

The Examiner is thanked for thoroughly reviewing the application. All claims discussed above are now believed to be allowable. If the Examiner has any questions regarding the above application, please call the undersigned attorney at 845-452-5863

Respectfully submitted,


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VERSION WITH MARKINGS TO SHOW THE CHANGES MADE.**In the Drawings.**

Fig. 1 has been amended by insertion of the legend "Prior Art," to properly indicate that it is a representation of prior art.

In the Claims.

Claim 51 has been canceled.

Claim 52 is amended as follows.

52. (AMENDED) A magnetoresistive read head with laminated magnetic shields comprising:
a first laminated magnetic shield;
a magnetoresistive sensor element formed on said first laminated magnetic shield;
a second laminated magnetic shield formed on said magnetoresistive sensor
element[. The structure of claim 51];

wherein the first laminated magnetic shield comprises:

a substrate;
a layer of Al₂O₃ of thickness between 0.5 microns and 10 microns formed
on said substrate;
a first layer of ferromagnetic material formed on said layer of Al₂O₃;

a layer of ruthenium formed on said first layer of ferromagnetic material;
a second layer of ferromagnetic material formed on said layer of
ruthenium;
a dielectric layer formed on said second layer of ferromagnetic material.

Claim 64 is amended as follows.

64. (AMENDED) A magnetoresistive read head with laminated magnetic shields comprising:
a first laminated magnetic shield;
a magnetoresistive sensor element formed on said first laminated magnetic shield;
a second laminated magnetic shield formed on said magnetoresistive sensor
element[.] [The structure of claim 51];
wherein the first laminated magnetic shield comprises:
a substrate;
a first layer of ferromagnetic material formed on said substrate;
a first layer of CoFe formed on said first layer of ferromagnetic material;
a layer of ruthenium formed on said first layer of CoFe;
a second layer of CoFe formed on said layer of ruthenium;
a second layer of ferromagnetic material formed on said second layer of
CoFe;
a dielectric layer formed on said second layer of ferromagnetic material.

Claim 77 is amended as follows.

77. (AMENDED) A magnetoresistive read head with laminated magnetic shields comprising:

a first laminated magnetic shield;

a magnetoresistive sensor element formed on said first laminated magnetic shield;

a second laminated magnetic shield formed on said magnetoresistive sensor element[. The structure of claim 51];

wherein the second laminated magnetic shield comprises:

a substrate;

a layer of Al₂O₃ of thickness between 0.5 microns and 10 microns formed on said substrate;

a first layer of ferromagnetic material formed on said layer of Al₂O₃;

a layer of ruthenium formed on said first layer of ferromagnetic material;

a second layer of ferromagnetic material formed on said layer of ruthenium;

a dielectric layer formed on said second layer of ferromagnetic material.

Claim 89 is amended as follows.

89. (AMENDED) A magnetoresistive read head with laminated magnetic shields comprising:

a first laminated magnetic shield;

a magnetoresistive sensor element formed on said first laminated magnetic shield;

a second laminated magnetic shield formed on said magnetoresistive sensor element[. The structure of claim 51];

wherein the second laminated magnetic shield comprises:

a substrate;

a first layer of ferromagnetic material formed on said substrate;

a first layer of CoFe formed on said first layer of ferromagnetic material;

a layer of ruthenium formed on said first layer of CoFe;

a second layer of CoFe formed on said layer of ruthenium;

a second layer of ferromagnetic material formed on said second layer of CoFe;

a dielectric layer formed on said second layer of ferromagnetic material.